

UNIVERSITIES OF MANCHESTER LIVERPOOL
LEEDS SHEFFIELD AND BIRMINGHAM

Joint Matriculation Board

General Certificate of Education

CHEMISTRY. PAPER II
ADVANCED

THURSDAY 20 JUNE 1957, 2-5

Answer six questions as follows:

- (a) **two** from SECTION (1);
- (b) **two** from SECTION (2);
- (c) **two** from SECTION (3).

Answers to Sections (1), (2) and (3) must be written in different answer-books.

The books must be marked clearly either SECTION (1) or SECTION (2) or SECTION (3) and handed in to the Supervisor separately.

Candidates should wherever possible show by their answers that they have seen or themselves performed experiments on the subjects they are discussing.

Chemical equations should be written for definite chemical reactions wherever possible.

The following data may be required:

Atomic weights: H = 1, O = 16, Na = 23, S = 32,
Cu = 63.5, I = 127.

SECTION (1)

Answer two questions from this section.

- ✓ 1. Describe the manufacture of iodine from the salt deposits in Chile.

How and under what conditions does iodine react with (a) potassium hydroxide, (b) sodium thiosulphate?

3.810 gm. of a copper salt were dissolved in water and made up to 250 c.c. To 25 c.c. portions of this solution excess of potassium iodide was added and the iodine liberated was found to require 15.15 c.c. of

$\frac{N}{10}$ sodium thiosulphate solution. Calculate the percentage of copper in the salt.

- ✓ 2. Name **two** general properties of covalent compounds and **two** general properties of electrovalent compounds. Explain carefully, using carbon tetrachloride as an example, the nature of the covalent link.

Classify the following substances as electrovalent or covalent and give in each case their electronic structures: (a) hydrogen chloride, (b) calcium sulphide, (c) magnesium chloride, (d) ammonia.

3. By means of equations and brief notes on reaction conditions, indicate the methods by which the following may be prepared:

- (a) ferric sulphate from metallic iron,
- (b) lead sulphate from metallic lead,
- (c) anhydrous aluminium chloride.

Write equations showing the effect of heat on (d) hydrated ferrous sulphate, (e) red lead, (f) silver nitrate.

4. Discuss the chemical reactions which give rise to the following observations:

(a) To a solution of oxalic acid, acidified with dilute sulphuric acid and warmed to 60°C ., potassium permanganate solution is added. The colour of the potassium permanganate is quickly discharged.

(b) When concentrated sulphuric acid is added to potassium bromide an acid fuming gas is evolved together with brown vapours. A piece of filter paper soaked in potassium dichromate solution and held near the mouth of the tube is turned green.

(c) To an ammoniacal solution containing copper ions and cadmium ions, potassium cyanide solution is added until the blue colour is destroyed. On hydrogen sulphide being passed through this solution a yellow precipitate is obtained.

(d) When hydrogen sulphide is passed into an acid solution containing a high concentration of nitrate ion a white turbidity is seen.

SECTION (2)

(Answers to be written in a separate answer-book.)

Answer two questions from this section.

- ✓ 5. Define the boiling-point of a liquid.

Explain how the boiling-point of a mixture of two miscible liquids can vary with the relative amounts of each. Show how the compositions for the liquid and vapour in equilibrium with each other may be represented graphically.

Explain what is meant by a 'constant-boiling-point mixture', and how you would distinguish between a pure compound and a constant-boiling-point mixture.

The vapour pressure of water at 40°C . is 54.9 mm. Hg. Calculate the vapour pressure at 40°C . over a solution containing 1 gm. molecule of acetamide dissolved in 900 gm. of water.

6. State the law which describes the ratio in which a solute distributes itself between two immiscible solvents.

How would you test the law for the case of oxalic acid distributed between ether and water? Give all essential experimental details.

An aqueous solution containing 0.11 gm. of phenol per litre is in equilibrium with an amyl alcohol solution containing 1.76 gm. of phenol per litre. What weight of phenol is extracted from 400 c.c. of an aqueous solution containing 15 gm. of phenol per litre by shaking it with 100 c.c. of amyl alcohol? (Phenol dissolves with its normal molecular weight in each solvent.)

7. What is meant by the term 'active mass' in relation to chemical reactions?

For the water-gas equilibrium at $1,000^{\circ}$ Abs., $\text{H}_2\text{O} + \text{CO} \rightleftharpoons \text{H}_2 + \text{CO}_2$, in which 8,300 cal. are evolved,

the equilibrium constant $\frac{p_{\text{H}_2} \cdot p_{\text{CO}_2}}{p_{\text{H}_2\text{O}} \cdot p_{\text{CO}}}$ equals 3.24.

A mixture of equal volumes of water vapour and carbon monoxide is allowed to reach equilibrium at $1,000^{\circ}$ Abs. at a total pressure of 1 atm. What is the final percentage composition by volume of the mixture?

(a) If the total pressure is altered to 0.1 atm., what will be the composition?

(b) If the temperature is raised, will there be more or less hydrogen in the equilibrium mixture?

Give appropriate explanations for (a) and (b).

✓ 8. Explain the meaning of the terms 'strong' and 'weak' as applied to acids and bases, and give an account of the ways in which strong acids and bases differ from weak acids and bases as regards the physico-chemical properties of their solutions. State, with reasons, whether the terms 'strong' and 'weak' are applied to salts.

Describe how you would determine experimentally whether a given normal solution of an unknown acid was that of a strong or a weak acid. Explain the underlying theory of the method.

SECTION (3)

(Answers to be written in a separate answer-book.)

Answer **two** questions from this section.

9. Describe with *full* practical details how you would prepare and purify a specimen of *m*-dinitrobenzene, starting from nitrobenzene.

✓ 10. The characteristic properties of typical reactive groups, as shown in aliphatic compounds, are frequently modified when these groups are attached to the benzene ring. From consideration of **two** chemical properties of each group, show how this is true in the case of (a) $-\text{OH}$, (b) $-\text{Cl}$, (c) $-\text{NH}_2$.

Briefly indicate (without practical details) how you would obtain specimens of chlorobenzene, aniline and phenol from a mixture of the three.

11. State briefly how benzoyl chloride may be prepared.

Compare the physical properties of acetyl chloride and benzoyl chloride and their behaviour towards water.

Describe carefully what you would observe and explain the reactions which occur when

- (a) benzoyl chloride is poured into cooled concentrated ammonia solution;
- (b) acetyl chloride is added to aniline and the mixture is diluted with water;
- (c) benzoyl chloride is boiled with aqueous sodium hydroxide, cooled, and excess of hydrochloric acid is added.

✓ 12. Explain concisely and completely the meaning of the following statements.

- (a) Ethyl ether and butyl alcohol are structural isomers.
- (b) Carbonyl compounds form condensation products with phenylhydrazine.
- (c) The monohydric alcohols form a homologous series.
- (d) Benzene may be sulphonated by heating under reflux with concentrated sulphuric acid.